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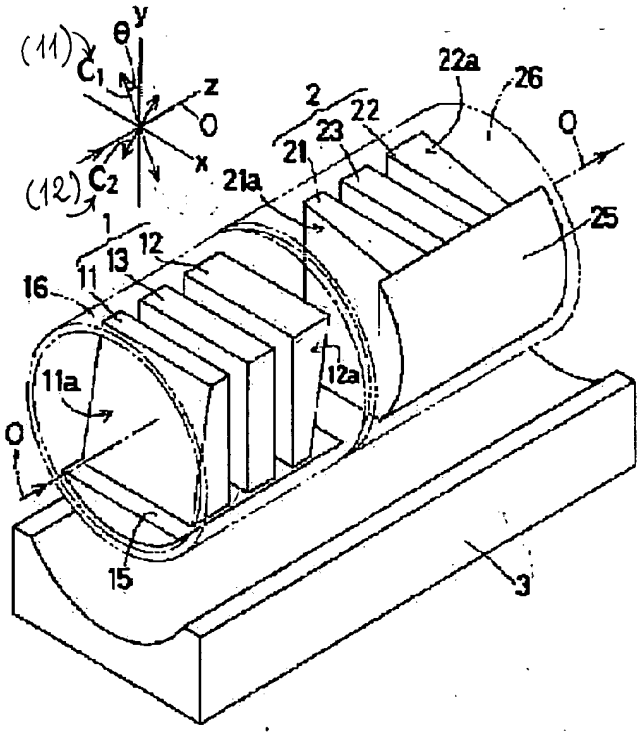
Title of invention: MANUFACTURE OF POLARIZATION-INDEPENDENT TYPE OPTICAL ISOLATOR
Abstract:

PROBLEM TO BE SOLVED: To provide a method for manufacturing a polarization-independ type optical isolator, which has large isolation and small polarization dispersion, efficiently in a high yield.
SOLUTION: To manufacture the polarization-independent type optical isolator constituted by putting one over the other two stages of isolator units, constituted by arranging 1st wedgelike birefringent crystal plates 11 and 12. Faraday rotators 13 and 23, and 2nd wedgelike birefringent crystal plates 12 and 22 in order, in series by rotating their wedgelike slanting surfaces on a center axis by 90°, the 1st stage of the isolator unit 1 and the 2nd stage of the isolator unit 2, which are previously assembled, are put one over the other; while a coherent light beam is made incident from the isolator unit side of the 1st stage and the polarization dispersion of a forward transmitted beam exiting from the isolator unit of the 2nd stage is measured, the isolator unit of the 1st stage or 2nd stage is rotated on the center axis and the position where the polarization dispersion becomes minimum is fixed as the position of the said 90° rotation.



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Other Drawings

(57)
[ABSTRACT]
(Amended)
[PROBLEM TO BE SOLVED]
The method which big isolation is owned, and produce the polarized wave no dependence mold optical isolators that polarization dispersion is small for efficiency by high interest coming to a stop is provided.
[SOLUTION]
After putting isolator unit 1 of the first column assembled in production method of the first polarized wave no dependence mold optical isolator which 90 degrees turn each wedge-shaped inclined surface about a medial axis, and put two steps on top of one another in series of the isolator unit which set wedge-shaped birefringence crystal board 11,21 and wedge-shaped birefringence crystal board 12,22 of faraday rotator 13,23 and the second in a sequence beforehand and isolator unit 2 of the second column on top of one another, it makes the first light beam which is coherent be incident from isolator unit side of column, while measuring polarization dispersion of a forward direction transmitted beam to emit from isolator unit of the second column, isolator unit of isolator unit of the first column or the second column is turned about a medial axis, polarization dispersion fixes lay becoming smallest as lay of the 90 degrees revolution.

[WHAT IS CLAIMED IS:]

[Claim 1]
After putting isolator unit of isolator unit and the second column of the first column assembled in production method of the first polarized wave no dependence mold optical isolator which 90 degrees turn each wedge-shaped inclined surface about a medial axis, and put two steps on top of one another in series of the isolator unit which set faraday rotator and the second wedge-shaped birefringence crystal board beside wedge-shaped birefringence crystal board in a sequence beforehand on top of one another, it makes the first light beam which is coherent be incident from isolator unit side of column, while measuring polarization dispersion of a forward direction transmitted beam to emit from isolator unit of the second column, isolator unit of isolator unit of the first column or the second column is turned about a medial axis, it is production method of the optical isolator which polarization dispersion fixes lay becoming smallest to as lay of above 90 degrees revolution.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[TECHNICAL FIELD OF THE INVENTION]
The present invention relates to a method for the manufacture of and it is optical communication system incorporated optical isolator polarized wave no dependence mold optical isolator.
[0002]

[PRIOR ART]
A thing of dependence mold no there is the optical isolator which it is not put in but it is put in forward direction of optical communication system incorporated optic glow transmission reverse direction polarized wave dependence mold polarized wave is conventional and known in the art. A polarized wave dependence type optical isolator, only polarization having a particular plane of polarization transmits in forward direction, because the reflected ray and glow of a reverse direction it is, and to come back intercept using property of polarization, the forward direction carbonizable substances which is not polarization light source (insertion loss) becomes bad, but, so-called polarization dispersion (PMD:Polarization Mode Dispersion) does not produce for theory. A polarized wave no dependence mold optical isolator makes forward direction transmit in glow of *bon yuru* polarized component without being influenced a plane of polarization for this, because glow of a reverse direction is a system thing outside, to lead, phase contrast appears between each polarized component after penetration, in other words polarization dispersion produces, but, there is a little loss of forward direction carbonizable substances.
[0003]
A polarized wave no dependence mold optical isolator has been developed from the standpoint that attached great importance to betterment of insertion loss conventionally by a master. In the field that speedup of communication, densification are needed, an optical isolator having big isolation is called for, a polarized wave no dependence mold optical isolator satisfying this claim is disclosed by Japanese Patent Publication No. 61-58811 bulletin. As for this polarized wave no dependence mold optical isolator, is repeated the optical isolator which set the first wedge-shaped birefringence crystal board and faraday rotator and the second wedge-shaped birefringence crystal board in a sequence in series to two

steps, 90 degrees are made to rotate a wedge-shaped inclined surface coping at each optical isolator interval about a medial axis. If adjustment of counterpart an angle of 90 degrees between each optical isolators is preferable, isolation to go over 50dB which is recent claim cross level can be realized.

[0004]

On the other hand, Because it is in factor making corrugation of sign pulse of optical communication deteriorate with a thing to produce from difference of light path length as opposed to polarized wave component as for the polarization dispersion occurring with a polarized wave no dependence mold optical isolator, it is necessary to control as much as possible. It is wished that polarization dispersion 0.1 are made less than PS (Pico Second) in recent claim cross level. It is assumed that a polarized wave no dependence mold optical isolator of the described above assembling can control polarization dispersion according to description of Japanese Patent Laid-Open No. 6-11664 bulletin.

[0005]

[PROBLEM TO BE SOLVED BY THE INVENTION]

When this polarized wave no dependence mold optical isolators are produced, what counterpart an angle of 90 degrees of two optical isolators are adjusted closely, and is fixed need between considerable skill and hand. While marker is referred to each optical isolator, and doing a measurement of dimension, because it is inaccuracy only by adjusting counterpart angle, while it makes glow really transmit, and measuring insertion loss of a reverse direction, an optical isolator of on the other hand is turned, the technique which the insertion loss fixed the lay which became greatest to in this lay as being the best adjustment angle had stolen. Because isolation is difference with light transmittance of forward direction (insertion loss of forward direction) and light transmittance of a reverse direction (insertion loss of a reverse direction), it is necessary for the same condition namely counterpart angle of two optical isolators rotates, and the polarized wave no dependence mold optical isolator which should measure to measure light transmittance of forward direction and a reverse direction in the condition which there is not. If change for each time in forward direction and a reverse direction in light source and optical receiver dated, this which measure isolation once are not repeated many times, because isolation was not able to adjust in the lay which became greatest, efficiency is bad.

[0006]

Even more particularly, Even if it is a polarized wave no dependence mold optical isolator of the big isolation that it adjusts in this method, and was provided, polarization dispersion is always reduced enough, and there can be the thing that there is not.

[0007]
The present invention provides the method which big isolation is owned with the thing which was done to break off such problems, and produce the polarized wave no dependence mold optical isolators that polarization dispersion is small for efficiency by high interest coming to a stop.
[0008]

[MEANS TO SOLVE THE PROBLEM]
As for the present inventor, diversity examines isolation of the conventional polarized wave no dependence mold optical isolator and connection with polarization dispersion, as a result of having analyzed for statistics, polarization dispersion may not be always small because big isolation is had, but, if polarization dispersion is low, if isolation gets finding to become big, and the present invention is finished, it was reached.
[0009]
After putting isolator unit of isolator unit and the second column of the first column assembled in production method of the polarized wave no dependence mold optical isolator which 90 degrees turn each wedge-shaped inclined surface about a medial axis, and put two steps on top of one another in series of the isolator unit which set birefringence crystal board and the faraday rotator that the first is wedge-shaped as for the production method of a polarized wave no dependence mold optical isolator of the present invention which was done to achieve the object and the second wedge-shaped birefringence crystal board in a sequence beforehand on top of one another, it makes the first light beam which is coherent be incident from isolator unit side of column, while measuring polarization dispersion of a forward direction transmitted beam to emit from isolator unit of the second column, isolator unit of isolator unit of the first column or the second column is turned about a medial axis, polarization dispersion fixes lay becoming smallest as lay of the 90 degrees revolution.
[0010]

[MODE FOR CARRYING OUT THE INVENTION]
It is equal to or less than, and embodiment of production method of a polarized wave no dependence mold optical isolator applying the present invention is explained when taken in conjunction with drawing.
[0011]
At first material to prepare beforehand is four pieces of wedge-shaped birefringence crystal board 11.12.21.22, two pieces of faraday rotator 13.23 which polishing finished in the same dimension that 45 degrees rotate plane of polarization, two arc

column board 15.25 of same dimension and two cylinder holders 16.26 that cylinder magnet (not shown) of dimension covering faraday rotator 13 (or, 23) is had on longitudinal central part, and it is crowded shown in FIG. 1. Birefringence crystal board 11.12.21.22 are processed into wedge inclined surface 11a .12 a .21 a .22 a of the each same angle, and durability, a wedge inclined surface and counterpart connection of optical axis include optical axis in appointed direction, and same, it is finished all.

[0012]

Inclined surface 11a is turned to forward direction (cf. arrow of medial axis O) incidence side of glow, and inclined surface 12a is turned to wedge base of birefringence crystal board 11, faraday rotator 13 and side to emit, and wedge crest arm of birefringence crystal board 12 is bonded to arc pillar board 15 by adhesive. Optical isolator unit 1 is provided by the whole is interposed in cylinder holder 16, and fixing.

[0013]

In a like manner, birefringence crystal board 21, faraday rotator 23 and birefringence crystal board 22 is bonded to arc pillar board 25 by adhesive , in what the whole is interposed in cylinder holder 26, and is fixed, optical isolator unit 2 is provided. Optical isolator unit 2 becomes optical isolator unit 1 and same shape.

[0014]

Next, It is set, and optical isolator unit 1 and optical isolator unit 2 are put on series to *hekomi* arc jig 3 having cylinder holder 16 and 26 outer diameter and equivalence bore diameter. And wedge inclined surface 11a of birefringence crystal board 21 and 22 and 12a rotate 90 degrees about medial axis O as against wedge inclined surface 11a of each birefringence crystal board 11 and 12 and 12a because generally 90 degrees turn optical isolator unit 2 in counterclockwise direction for optical isolator unit 1.

[0015]

In this state, as shown in FIG. 2, coupled collimator 6 is tied to a forward direction plane of incidence of optical isolator unit 1 with optical fiber 5 of single mode to laser diode 4, coupled collimator 7 is tied to face emitting forward direction of optical isolator unit 2 with optical fiber 8 of single mode to polarization dispersion measuring instrument 9. Emission wavelength of laser diode 4 is wave length of the communication system which a polarized wave no dependence mold optical isolator is used for. For polarization dispersion measuring instrument 9, there is H P -8509 B made in Hewlett Packard (HewlettPackard) company to a commercial article.

[0016]

It makes a laser beam from laser diode 4 be incident, while determination watches

optical isolator unit 1 and the beam which it transmits in forward direction, and emit 2 with polarization dispersion measuring instrument 9, optical isolator unit 2 is turned by the few about medial axis O on *hekomi* arc jig 3. Polarization dispersion value measured with polarization dispersion measuring instrument 9 became smallest, and the polarized wave no dependence mold optical isolator which is directed to revolution because adhesion fixes stop, optical isolator unit 1 and 2 to mutual is provided.

[0017]

As for *shi* ta, the optical axis of birefringence crystal board 11, it is in direction shown in C 1 of x-y-z coordinate of FIG. 1 from forward direction of optical transmission in optical isolator unit 1 of a finished polarized wave no dependence mold optical isolator. Optical axis of birefringence crystal board 12 becomes direction shown in C 2 identically identically. Therefore, It is in plane symmetry about y-z grade level (and plane z-x) with optical axis C 1 of birefringence crystal board 11 and optical axis C 2 of birefringence crystal board 12. Outside graphic display *shi* ta, birefringence crystal board 21 and 22 optical axis from forward direction of optical transmission in optical isolator unit 2 identically, but, it is in optical axis C 1 of each birefringence crystal board 11 and 12 and the direction which rotated 90 degrees as against C 2.

[0018]

About a polarized wave no dependence mold optical isolator, a performance test of prototype was done.

[0019]

In each optical isolator unit, the following accessories was done. The birefringence crystal board finished Ti O_2 single crystal to angle (FIG. 1, angle theta of x-y coordinate) 48 degrees of optical axis, contour 1.2mm ? , caliper 0.5mm of wedge crest arm (most haku part), an angle of 4 degrees of a wedge inclined surface. The faraday rotator processed Bi metathesis type YIG single crystal into outer circumferential 1.2mm ? , caliper 0.6mm (equivalent to Faraday rotation angle 45 degrees).

[0020]

In optical isolator unit produced experimentally in this accessories, 100 polarized wave no dependence mold optical isolators were produced experimentally by production method of the present invention. In addition, As for the apparatus which employed for this trial manufacture, as for laser diode 4 (FIG. 2 reference), optical isolator unit 1 and 2 are put to wave length 1550nm, collimator 6 and 7 between mutual distance 300mm in a street shown in FIG. 2 by an aspherical lens. It is adjusted so that a collimated beam of 300 mu m phi emits from collimator 6.

Optical isolator unit mutual was positioned so that polarization dispersion became minimum value with polarization dispersion measuring instrument 9 at the time of trial manufacture.

[0021]

The polarization dispersion of a polarized wave no dependence mold optical isolator of 100 prototype (equivalent to minimum value) was less than 0.1 PS (Pico Second) both. In addition, 50dB was older than both when it measured by conventional method light transmittance of forward direction and light transmittance of a reverse direction were measured, and to compare isolation of a polarized wave no dependence mold optical isolator of these 100 prototype.

[0022]

For comparative purposes, 100 polarized wave no dependence mold optical isolators were produced experimentally by conventional method. The above is same, and generally 90 degrees turn two optical isolator unit produced experimentally, and it will be set, while it makes a laser beam same as the above transmit, and measuring isolation, an optical isolator of on the other hand is turned, isolation adopted the method which adhesion fixed two optical isolator unit to in the lay which became greatest. As for the isolation of a polarized wave no dependence mold optical isolator of these 100 comparison prototype, 50dB was older than both. Even more particularly, it was distributed extensively when polarization dispersion of these 100 comparison prototype was measured with polarization dispersion measuring instrument 9 same as the above.

[0023]

If, as a result of prototype and performance analysis of comparison prototype, polarization dispersion is small as above, isolation becomes big, but, *gen* was become because big isolation was had that polarization dispersion was always small. Therefore, polarization dispersion is small and, a polarized wave no dependence mold optical isolator produced by production method of the present invention, a big thing is provided isolation.

[0024]

[EFFECT OF THE INVENTION]

According to production method of the present invention, isolation increases a provided polarized wave no dependence mold optical isolator as had explained in detail and polarization dispersion becomes a small thing as things mentioned above. In manufacturing process, in confirmation of polarization dispersion, hold, and it appears, a big thing is provided isolation, and, in *no*, yield extremely can well produce polarized wave no dependence mold optical isolators for efficiency.

[BRIEF DESCRIPTION OF DRAWINGS]

[FIG. 1]
It is a perspective diagram in the way producing polarized wave no dependence mold optical isolators by production method applying the present invention.
[FIG. 2]
It is arrangement drawing in the way producing polarized wave no dependence mold optical isolators by production method applying the present invention.
[DENOTATION OF REFERENCE NUMERALS]
Arc column board, 16.26 are cylinder holders faraday rotator, 15.25 wedge inclined surface, 13.23 birefringence crystal board, 11a .12 a .21 a .22 a polarization dispersion measuring instrument, 11.12.21.22 collimator, 9 optical fiber, 6.7 laser diode, 5.8 *hekomi* arc jig, 4 optical isolator unit, 3 1.2.